

## §27. Hot Cathode Biasing Experiment in CHS

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The electrode biasing experiment in Compact Helical System was carried out in order to investigate the role of a radial electric field for an improvement of plasma confinement. The hot cathode made of LaB<sub>6</sub>, used as an electrode to form a radial electric field, is inserted horizontally from the low magnetic field side. The filament is cylindrical (diameter is 10 mm, length is 17 mm) and double spiral structure to cancel the induced magnetic field. It is heated to ~ 1800 °C using a power supply. The electrode was biased against the vacuum vessel by a current control power supply. In this study, we attempted to control the poloidal driving force to clarify the bifurcation originated from the ion viscosity. The poloidal driving force is the Lorentz force of  $\mathbf{J} \times \mathbf{B}$ . Thus, it can be changed continuously by the electrode current control. The position of the electrode for the plasma is shown in Fig. 1.

The neoclassical theory points out the criterion of LH transition from the viewpoint of the ion viscosity. In this theory, the ion viscosity has local maxima against the rotation velocity [1, 2]. When the driving force in poloidal direction exceeds a critical value, the poloidal rotation velocity increases rapidly and the plasma makes transition to the H mode. It means that LH transition mechanism is the bifurcation phenomena originated from the existence of the local maxima in the ion viscosity. Figure 3 shows the dependence of calculated ion viscosity  $\Pi_{p,n}$  for CHS based on the Shaing [1] or Rozhansky model [2] on the poloidal Mach number  $M_p$ .  $M_p$  is the poloidal flow velocity normalized by the ion thermal velocity. As can be seen in Fig.3, ion viscosity has local maximum near  $M_p \sim 2$  in both model of Shaing and Rozhansky. If enough radial electric field corresponding to  $M_p > 2$  is attained, the plasma make transition to enhanced mode. In the experiment, which the target plasma was produced by an electron cyclotron heating of 2.45 GHz, the estimated  $M_p$  was 1.2; therefore it is thought that the plasma remained low confinement state in that condition. Moreover, the friction force which is one of the poloidal momentum damping force caused by charge exchange between ion and neutral particle was not negligible in such high collisional plasma. It means that larger poloidal driving force was required for transition.

The experiment will be extended to a low collisional and/or high temperature plasma at high toroidal field in order to clarify the role of the ion viscosity for the transition to the enhanced confinement mode.

### Reference

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- [25] V. Rozhansky and M. Tendler: Phys. Fluids B **4**, 1877 (1992).

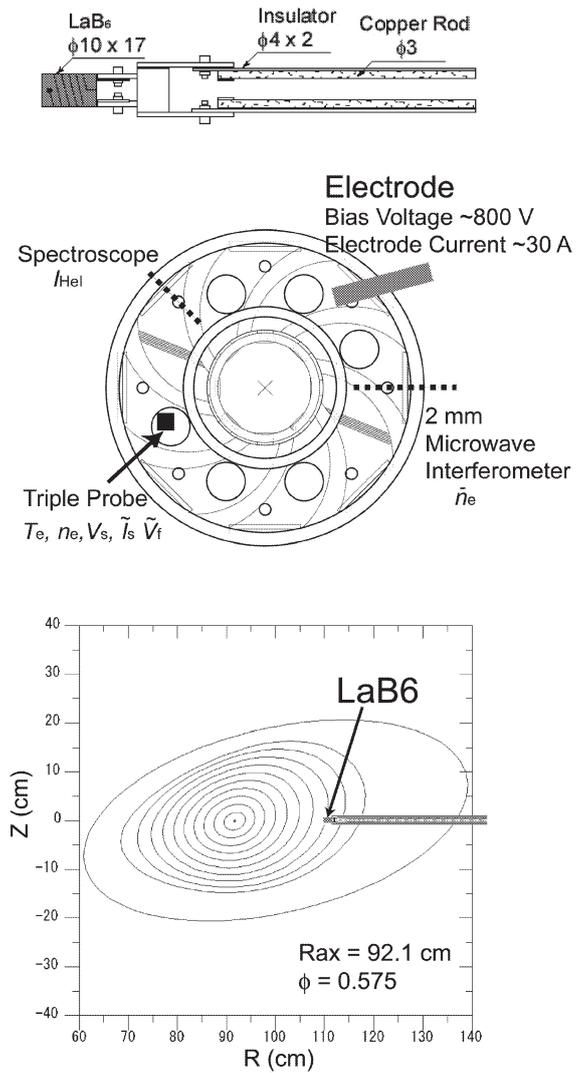


Fig. 1. The location of hot cathode for CHS plasma.

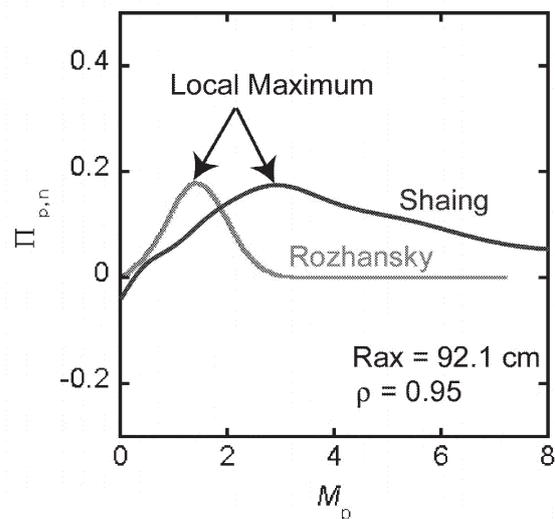


Fig. 2. Relation between ion viscosity and poloidal Mach number.